

A Semiotic Approach To Investigating Presence

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ABSTRACT

Computers these days are highly complex devices that consist not only of simple computational forms but also of complex cultural forms derived from other media. A good interaction designer understands this media and how combinations of components result in engaging interaction. Presented here is our semiotic model of interaction that considers the computer as a medium. As part of the EU Presence initiative we are contributing to developing measures of presence that will provide designers with a pattern language for designing presence. This new medium needs new approaches to assist designers and the semiotics of interactive systems is such an approach.

Keywords Semiotics, Medium, Embodiment, Interaction, Presence

1. INTRODUCTION

Changes are afoot and concepts about new media are becoming increasingly important. These new media are interactive systems worn or embedded in environments, with physical tangible interfaces augmented by graphics or virtual environments augmented by physical objects. New media demand new approaches to interaction design and new foundations upon which to build our understanding.

In this paper we explore some of these new foundations. Our own work is to look at semiotics as a new foundation for interactive systems design. Of course semiotics is very old but if brought up to date it offers a level of discourse for discussing design issues that seems appropriate. We do not want to discuss the details of buttons and menus or the efficiency of tasks, as has been the focus of traditional HCI. We want to phrase discussions in terms of the interpretations, meanings and significances that people experience living in a world of interactive systems.

The paper is organised as follows. Section 2 introduces the notion of interactive systems as a medium and what it means to think about interactive technologies in this way. Section 3 introduces semiotic analysis and the model of semiotics that we have developed to help understand interactive systems. Section 4 describes some preliminary empirical work and in Section 5 these and other features of our analysis are related to other concepts of embodiment. Section 6 introduces the concept of presence including work on the BENOGO project and Section 7 provides a conclusion and some considerations about future work on presence as non-mediated interaction.

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2. INTERACTIVE SYSTEMS AS MEDIUM

Malcolm McCullough in his engaging book *Abstracting Craft* [20] devotes a whole chapter to medium. He says a “medium may be a material such as plaster, or a means, an agency or an instrumentality. It may be an intervening person or thing or some other kind of carrier. It may be a pervasive environment” (p. 193). McCullough gives the example of wood as a medium. The artist/designer works within the medium using his or her tools such as chisels. But he also acknowledges how the idea of a tool can soon become a medium in its own right as the artist expresses ideas in wood through the chiselling. This leads to three important features of media; affordances, constraints and engagement.

Wood affords chiselling. The medium has certain characteristics that interact with the person through the tool/medium of the chisel that provide possibilities for action. You can't chisel metal. But just as the medium affords possibilities so it constrains activities as well. The wood will break if it is chiselled too thin. The third feature of medium is 'engagement'. A medium is engaging if it draws the person in, if it seems to surround the activity, if it stimulates the imagination. McCullough argues that an engaging medium allows for continuity and variety, for 'flow' and movement between many subtle differentiations of conditions. “Thus the attuned craftsman asks ‘what can this medium do?’ as much as ‘what can I do with this medium’” (p. 198). A medium establishes a world of actions (p. 120).

Digital Media or New Media, as it has become known [19], can be considered to be an extension of Marshall McLuhan's ideas of Mass Media [21]. His statement “The Medium is the Message”, is seen as an attempt to address the way in which new mediums affect the messages that we use to communicate.

In terms of trying to understand the computer as a medium it can easily be argued that these digital media are simply elements constructed from the 1's and 0's of binary code. However, computers these days are highly complex devices that consist not only of simple computational forms but also of complex cultural forms derived from the other media that they are now able to support such as video, sound, graphics, haptics and so on. [19]. The parameters, and qualities of the computer as medium have increased dramatically as they have taken these new forms on board. Indeed the very nature of these older forms of media have been subject to change by the qualities of the computer and must now be understood within this new context [20].

The media that the interaction designer has to work with consists of all the different forms and functions of input and output and all the manipulations that can be performed on the content. The interaction designer has software tools and hardware devices, screen displays, sounds and haptics (touch) with which to create

an engaging, effective and efficient experience for the people involved in the interaction. A good interaction designer will understand this media and how combinations of components will result in an engaging interaction. The good designer will understand what the medium affords and the constraints that it imposes.

3. SEMIOTICS AND INTERACTIVE MEDIA

Research by the Semiotic Engineering Group (SERG) takes the viewpoint that a user interface is a “one shot message” [24,25] sent from a designer to a user, which can be seen as a representation of the users needs as defined by the designer. Furthermore, this message contains a number of smaller messages that constitute the functional aspects of the interface, which are delivered and articulated by the signs that the designer has chosen to represent them. In Manovich’s terms the important thing about the one shot message is that it contains other messages and is therefore a metamessage. That is to say that the messages sent by designers to users contain more messages that are to be used by the users for their own ends. In the case of the computer as medium it is no longer sufficient to say that the “medium is the message” as McLuhan did. The “emergence of a new cultural metalanguage” [19] has turned the messages into the medium.

In our paper “Semiotics and Interaction Analysis” [23] the focus is on Umberto Eco’s “A Theory of Semiotics” [15] in relation to a semiotic analysis of mobile phone interfaces. Starting from the SERG perspective Eco’s revised KF model (Figure 1) is applied as a tool by which to analyse interactions looking at the meanings associated with the signs within mobile phone interfaces.

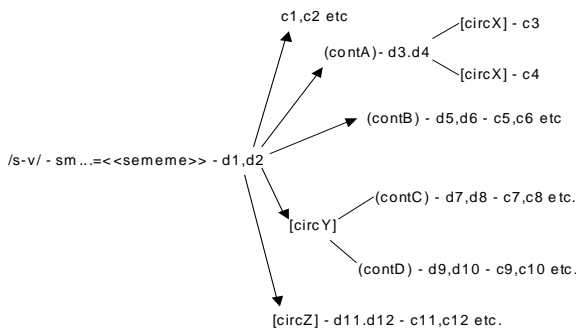


Figure 1 The Revised KF model (Eco, 1976)

The revised KF model is built around the notion that meanings can be extrapolated from signs as either denotations (labelled ‘d’ in Figure 1) or connotations (c) that are dependent on the context (cont) and circumstances (circ) in which the signs are encountered. The revised KF model then is a dynamic tool that looks at the way the meanings of signs change depending on where they are encountered. Applying these ideas to mobile phone interfaces uncovered how the meanings of individual signs are dependent on the context provided by the concurrent and sequential framing of other signs in the interface [1].

In our paper “Semiotics and Interactive media” [22] we present our semiotic model of interaction that considers the computer as a medium from a semiotic point of view (Figure 2). It is derived

from the work of Peter Bogh Andersen [2-4], SERG [6,11,12,25] and the HCI group at Napier University [7-9,23]). It consists of four main parts that are discussed below.

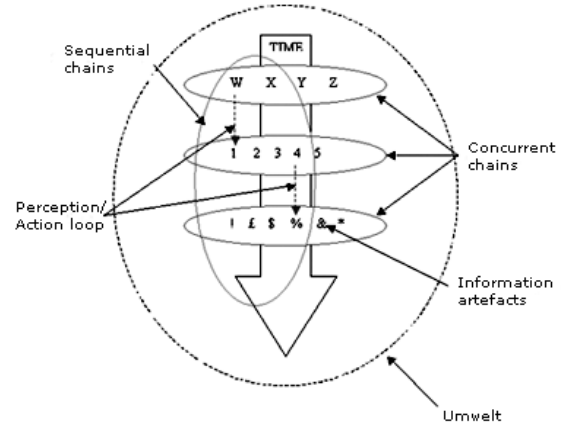


Figure 2 A Semiotic Model of Interaction with a Digital Medium

3.1 Sequential and Concurrent Syntagms

Peter Bogh Andersen’s semiotic notions of concurrent and sequential syntagms [2] provide an insight into HCI by abstracting a point of view from different media. Drawing on semiotic concepts from Theatre and Dance, Andersen focuses on the notions of the sequence of events in relation to the actors and props present on the stage. For Andersen computer based signs exist as two-dimensional objects that occupy both sequential and concurrent planes. During interaction computer based signs occupy a place in the interface, which is relative to other signs on the screen. As they are interacted with, they are brought into relation sequentially to other signs in the interface that occur as a result of system response.

Andersen proposes a model here that looks at the process of interaction based on the notion that it takes place through the manipulation of the signs within an interface over a period of time. What is unique in this description of interaction is that it can be viewed as a kind of discourse that takes place between the computer and the user in terms of the meanings each one can attribute to the signs as they are activated during the interaction.

3.2 The Umwelt

Jacob Von Uexkull’s conception of the Umwelt [13,16,26] is built upon the unique notion that all significations take place within the bounds of firstly, our genetic codes in terms of hereditary aspects of species, and secondly, the social codes within which we live as aspects of our environment into which we become indoctrinated as we develop and grow as people. There can be no signification outside these constraints because they are what give us a) the need to communicate and b) the means by which to do it. The Umwelt then is effectively the mass of knowledge that we carry around with us into every interaction, which has been formed and continues to form as a result of those interactions.

3.3 The Perception/Action Loop

Contained within Uexkull’s conception of the Umwelt is a model of the relationship between organism and environment, which is a

perception/action model that is at the heart of every interaction. It has some similarities to ideas proposed in HCI by information processing psychology but is perhaps closer to a phenomenological perspective that we will get to later. The fundamentally important thing about Uexkull's perception/action loop is that Uexkull characterises its operation in terms of signs rather than in terms of processing raw sensory data. This is an important shift in perspective.

Linked to Andersen's concurrent and sequential syntagms, Uexkull's perception/action loop can really be seen as the Human part of the interaction that makes sense of and manipulates the 'Information artefacts' [7] that exist in an interface. This activity, which produces sequential chains throughout an interaction, occurs between the two aspects of the sign i.e. the signifier and the signified, or here, the system and the user's Umwelt.

3.4 Information Artefacts

The traditional signs or information artefacts that make up an interface are the buttons, graphics and words that Andersen categorised in his book "Computer Semiotics" [2]. Since then however many new forms have come to be included in an interface to the point where we now have a 'new media interface' [19]. So the information artefacts in our model are considered to be all of the elements that now go into an interface which constitute the beginnings of this new metalanguage [19].

3.5 Medium

A sequence of actions, which are traditionally viewed as system state changes in HCI, can also be viewed as changes within a medium [20]. More specifically they are transformations within the medium that occur through the processes of the perception/action loop. The idea of medium proposed here in relation to our model, places the properties of the system in the hands of the messages or signs that communicate the system state. That is, the messages are the medium which are manipulated by both designers and users in a similar fashion in order to produce the object of their interaction, be it a piece of artwork, a selection of tunes on a media player or a new piece of software for somebody else to use.

McCullough's notion of craft [20] is applied to interaction here, framing the computer as a medium in which the user becomes expert in handling its specific properties. Much like the sculptor who is expert in understanding the medium of wood or stone or clay, the digital art worker is an expert in handling and manipulating the signs that construct the medium of that program. Conceptually s/he is aware of the systems properties and knows how to manipulate them through the signs to get the desired result.

4. THE MODEL AND MEDIATION

4.1 Preliminary Studies

Turning to the practical aspects of our research [22], we have been using a qualitative methodological approach in order to explore the particular aspects of our proposed model, and the more general notions of messages as medium that underpin it. Three preliminary studies were undertaken which focused on the notion of medium in different environments. The first two studies looked at subjects involved in using computer interfaces (Photoshop, and others) to design both print and electronic media. The third study was to provide a comparison to the software-controlled interfaces by looking at the 'real interface' of an artist working on a painting. The main aim was to explore the model

and to determine, through the observation and interpretation [18] of user interactions, how messages in an interface are defined; how the various forms of messages inform the user about the system; and what users do with these messages.

The secondary, but equally important aim, was to develop an appropriate method for examining the model in the field. This consisted of taking the basis of a method already tested in experiments with a semiotic perspective and adapting it to the field environment. The work of the Semiotic Engineering Group (SERG) provided us with the most suitable basis for a semiotic approach to fieldwork. Their concern with usability and system communicability [6,11,12,24] provides a well-established framework for conducting observational experiments that support a semiotic viewpoint. SERG have concentrated their efforts largely on 'one to one' interface interactions, which focus on the communicability of the interface in order to establish usability problems. Our work is somewhat different in focus as we are exploring aspects of our model and notions of mediation but we used the same talk-aloud principles employing a video camera rather than screen based capture equipment.



Figure 3 Information Artefacts

With this type of approach we were able to analyse the video footage from a semiotic perspective looking at the signs manipulated in the environment in relation to the tasks that participants performed and in relation to what they said about what they were doing. The types of data we got then were screen images showing the concurrent and sequential nature of sign use (Figure 3) and transcriptions of utterances by the participants (Figure 4) that correspond to the time coded screen shots from the video.

Time	Actions	Participant
[20:48:46]	Making a sign. Selects the 'path again. Chooses the dodge burn tool. Opens the brush palette. Selects shape and size. Back	"He's still there but he's not got that natural light shadow that's coming round here, so I'm gonna recreate that and just take him right back...make my

	up to tool bar to set exposure.	selection, shadow 6, take a hundred, he's quite big, exposure... start at 10 and work back from there"
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Figure 4 Transcriptions

What was interesting about the studies was that they not only confirmed the usefulness of concurrent/sequential paradigms in analysing data, it also linked them to notions about the Umwelt where sense making is a direct result of the perception/action loop as the user engages with the world [22]. This gives weight to the idea that even expert users perform work tasks in an exploratory way. Moreover, different 'zones' or 'modes' of activity were uncovered in these studies which users switched between throughout their interaction. Each one seemed to affect, if not at least overlap with the other.

5. EMBODIED INTERACTION

In *Where the Action Is* Paul Dourish develops his ideas on the foundations of embodied interaction [14]. The embodied perspective considers interaction 'with the things themselves'. Dourish draws on the phenomenological philosophy of such writers as Heidegger, Husserl and Merleau-Ponty and recent developments in tangible computing and social computing to develop a theory of embodied interaction. For Dourish, phenomenology is about the tight coupling of action and meaning.

Embodied interaction is concerned with two main features; meaning and coupling. Within meaning Dourish finds three types: ontology, intersubjectivity and intentionality. Ontology is concerned with how we describe the world, with the entities and relationships that we perceive – or rather with which we interact. Dourish is concerned with how we understand the computational world. Intersubjectivity is about how meaning can be shared with others. This involves both the communication of meaning from designer to user, so that the system can reveal its purpose, and the communication between users through the system. The task-artefact cycle is a familiar concept to HCI people; designers design some technology to support some task, but then the technology inevitably changes the nature of the task. Dourish is concerned with the ways in which we use technologies in our activities and how these affect the decisions we take, expectations we have and so on. The third aspect of meaning is intentionality. This is to do with the directedness of meaning and how it relates one thing to another.

Thus actions take on meaning for people. Coupling is concerned with making that relationship effective. If objects and relationships are coupled then the effect of actions can be passed through the system. Dourish uses the familiar example of a hammer (also used by Heidegger) to illustrate coupling. When you use a hammer it becomes an extension to your arm (it is coupled) and you act through the hammer onto the nail. You are engaged in the activity of hammering.

From this theory of embodied interaction – 'not just how we act on technology, but how we act *through* it' [14] – Dourish goes on to develop some high-level design principles:

1. Computation is a medium
2. Meaning arises on multiple levels
3. Users, not designers, create and communicate meaning
4. Users, not designers, manage coupling

5. Embedded technologies participate in the world they represent
6. Embodied interaction turns action into meaning.

The reason for exploring Dourish's notion of embodied interaction here is to note the similarities between his analysis and our own; in particular the concept of computation, or interactive systems in our terminology, as a medium. Where a semiotic analysis can go further, we think, is in the idea of meaning. Semiotics recognises that meaning itself is a complex web of significances. It is not simply the things that some information artefact denotes that is important, it is all the connotations that flow from the denotations, turning infinitely back on themselves, that characterises our understandings and feelings.

The zones of medium uncovered from the analysis of expert users of Photoshop correspond to the ideas of 'interacting with' and 'interacting through' that Dourish describes and, indeed, are characteristic of Winograd and Flores's earlier introduction of phenomenology to HCI [27]. Our analysis suggests a third zone – the larger medium in which the interaction that is the focus of attention takes place.

6. VIRTUAL ENVIRONMENTS

6.1 Presence

In research into tele-presence (or 'presence', as it is usually abbreviated) there is a topic known as 'the book problem'. This characterises the problem that we can feel really immersed and involved when reading a book. The medium through which we are interacting is apparently very impoverished compared, say, to cinema or virtual reality and yet the feeling of presence that we can experience can be quite considerable. You can really get transported to another place. The mistake, of course, is to think that the book is the medium. It is the words and skills of the storyteller that is the medium through which we interact with the significances that the story has for us. In the cinema the medium is very rich and much more realistic – at least in terms of visual fidelity. Even when the objects on the screen are impossible spacecraft, the hi-fidelity representation is characteristic of the medium. Of course you can 'drift off' at the cinema and lose the sense of presence (or feel presence in the new found reverie), just as you can when reading a book.

Designing for presence is about designing the illusion of non-mediation. When you put on a head mounted display you are immediately transported into the computed world beyond the headset. You are not aware that there are two tiny displays sitting close to your eyes; that part of the interaction is apparently unmediated. For remote tele-operation of vehicles and tools a feeling of non-mediation, or embodied interaction, would be an advantage. The person controlling the Mars Lander wants, ideally, to feel that he or she is really picking up the rock to examine it. The headset, the gloves, the transmitters, the robot arms all need to disappear into a single medium so that the controller feels that the interaction is unmediated, that it is embodied.

6.2 The BENOGO Project



Figure 5 BENOGO Demo 1 Equipment

The BENOGO project is a European funded project that concentrates on this notion of presence. We are contributing to this project by including a semiotic analysis of participant's interactions within these environments. Based on the model presented here our aim is to look at the types of meanings that people generate as they interact with these virtual environments (Figures 5 and 6) and to compare them with the types of meanings generated in similar real environments.

The BENOGO project is unique in that it uses real time Image Based Rendering (IBR) technology to create the visual component of the virtual environment. At this stage in the development of the technology The Region of Exploration (REX) has been restricted to one point of view and no movement within the environment is possible. However the singular point of view does provide full 360-degree head movement and stereo depth of field.



Figure 6 The BENOGO Botanical Environment

6.3 Talk-aloud analysis

The talk-aloud approach we used was part of a raft of techniques employed during data gathering in demo 1. 10 participants took part in this section of the BENOGO test while only half that amount took part in the benchmarking activities, which are an on going process. The talk-aloud method we used for this study was to a certain extent treated more like a live interview than the ones we had done previously [22]. This was largely due to the

restrictive nature of the first Demo where no movement or interaction was actually possible within the virtual environment. We could not effectively observe interactions with the virtual environment; therefore this first study was focused on a description of the significant aspects of the environment highlighting technical problems with the VE but limited in exploring the concept of presence.

The videos were first of all transferred from tape to hard disk for storage and easy access. They were then viewed a number of times to promote immersion in the data and a transcript of participants comments was rendered along with notes on aspects of visual, audio and timing of events. Analysis of the talk aloud method resulted in a number of factors that consistently recurred in all of the sessions. Broadly speaking these were grouped into the three categories that the talk aloud questions were designed to enquire about.

1. Description: The descriptive level of the environment: recognisable objects and features of the environment, trees, plants, bridge etc (6.4).
2. Significance: The personal subjective engagement with the environment. Feelings of calmness, pleasantness, lack of atmosphere and humidity, memories of holidays etc (6.5).
3. Realness: The technical limitations of the environment: cables, HMD, resolution etc (6.6).

Additionally there were two other main areas of interest that arose from the talk aloud sessions that were not considered before the tests, Movement (6.7) and Sound (6.8).

6.4 Descriptions, things and objects

In the BENOGO environment, the types of elements that people could see were obviously identifiable despite the resolution problems that arose due to the technical limitations. Interestingly enough participants often identified these technical problems as things that they could see in this descriptive section as if they were objects in the environment (e.g. "I can see stereo"). Every single participant commented on a computer generated sculpture that had been added to the world and how odd it looked.

In the real botanical garden in Edinburgh similar types of description occurred where participants identified particular objects such as trees, plants, water, the building etc. As well as these a number of other things were highlighted in the descriptions of the real world. Fish, birds, signposts, heat, humidity and people were all existent in the real world but not present in the BENOGO environment. The only time any of these things was mentioned in the BENOGO environment was to point out their absence. (Note: participants are labelled r-real, b-BENOGO)

"I see a garden, with a bridge and an object, looks like coming from a leaf, staying in the middle, then I see the sun on the leaves. I hear some water. I see the roof." Participant b2

"There is no moisture in the air, in my breathing or sensing on my skin. That's one of the things I'm missing" Participant b10

6.5 Significance and Memory

In terms of personal responses to the environments it was in the real world that much more reference to significance and memory occurred. Participants were often reminded of other places that

they had been. Other botanical gardens, gardens in general or places with hot climates. Cultural references to films such as the Jungle Book, Tarzan and general jungle films were mentioned and personal memories of holidays, family members and in the case of two Greek participants, home were also mentioned. In the BENOGO environment very little of this type of data was uncovered. There were some mentions of memories of other botanical gardens and holidays but very little that was as vivid as those in the real environment. In the BENOGO environment there were a few mentions of games and gaming related comments that were not present in the real environment.

“It reminds me of Kew Gardens I went there when I was younger, the other thing is the heat and the condensation it reminds me of a shower. Its very relaxing and quiet” Participant r1

“It reminds me of a place, a museum in Copenhagen which has a kind of indoor garden like this. It’s not the same actually but it sounds very much the same... it reminds me of being on a holiday in a different place. Actually it doesn’t remind me of a rain forest although it could be but there’s too much light in here.” Participant b10

6.6 Realness

In the BENOGO environment comments about realness were almost always couched in relative terms. Most people understood or pinpointed resolution problems that made the visuals seem unreal. At the same time most of the participants said that it ‘looked pretty real’ particularly in relation to other types of VR.

In the real environment the same thing happened but this time in reverse. Everybody understood that they were in a real environment and that they could see real things but the man-made construction of the physical environment brought out comments such as ‘fake’ or ‘unnatural’ that seemed to impinge upon participants sense of realness.

“It is an artificially created real place. Everything around me is real I can touch it. It is tangible.” Participant r1

“I think the way I see through the glass in here or whatever, is a bit blurry especially when I move quickly, but I think that it looks like a place that is here and I am looking through something.” Participant b14

6.7 Movement

Participants in the real world had much more freedom to move around the environment. In the BENOGO environment attempts to move and mentions of wanting to move were quite common across most participants but these were physically restricted by the cables of the HMD, and technically by the 1 point of view REX (Region of Exploration) of the environment.

“I get the feeling of being attracted to walking over the bridge or trying to step down on some other place maybe walk round, to explore it even more. This possibility of being able to move around this place would enhance the feeling of being there.” Participant b10

6.8 Sound

Sound also featured quite highly in both environments. In the BENOGO environment many participants commented on the sound and its suitability to the visuals. However many realised

that the sound was not necessarily connected to the visuals even although there was something directional about it. Comments often arose about cars outside, birds and the noise of water in the environment. These were sometimes accompanied by comments about the water not moving visually while it sounded like it was or no movement in the trees where birds might be. In the real environment sound comments were restricted to comments on the water, the humidifier being turned off and on, and the sense of quiet in the space.

“Sound, sound is very spatial it’s location based.” Participant b8

“I can hear this bird’s cry somewhere in the soundscape. So I, for a while, actually try to locate the bird. It seems to be impossible for me.” Participant b10

6.9 Discussion

In terms of the model presented earlier this BENOGO study points towards some interesting aspects of a semiotics of Virtual Environments. Although unlike our other studies [22], due to restricted interaction, it is still possible to see relationships with aspects of the model in our data. For example in the descriptive level we get a sense of artefacts in the environment trees, plants, bridge etc. These are examples of simple denotation active in the representational images of the environment. Furthermore there are examples of a more connotative semiotics present in the environments. These are captured through focusing on elements of significance and memory. In short this is the territory of the Umwelt. Here an environment such as a botanical garden can trigger a sense-making semiosis that allows cultural references to jungle movies or memories of holidays to take place. A link then is established between encountering the phenomena of the environment and the signification process within the Umwelt.

Although we are still early on in the BENOGO project, we consider that this approach has been useful in exploring the differences between real and virtual places. What it has highlighted, in a similar way to the Photoshop studies, is the relative difference in the richness between real and virtual environments. Denotative aspects come through strongly in both but connotative aspects are much stronger in the real world. This may have something to do with embodiment in terms of extra channels of sensory input that only occur through actually being in a place. It may also have something to do with the technical limitations of the technology that interferes with this feeling presence e.g. low resolution heavy HMD, etc. As the BENOGO project develops these are areas that we are keen to explore in terms of the concept of mediation and the semiotic model presented.

7. CONCLUSION

In this paper we have presented our approach to understanding interactive systems as new media. The reason why books such as those by Dourish and McCulloch and Manovich are appearing is because human-computer interaction is changing in the light of new media. Dourish refers to tangible computing and to social computing and the changes that these are bringing to the ways we think about HCI. We are currently working with photo-realistic virtual reality in order to investigate the notion of presence [5]. How can we design systems so that people feel they are somewhere else? As part of BENOGO we are contributing to developing measures of presence and aim to provide designers with a pattern language for designing for presence. The work

presented here contributes to this notion as we seek ways of measuring the 'amount' of mediation in an interaction on various dimensions such as fidelity, interest level, concentration level and so on. This is a radical departure from previous approaches to presence that have concentrated on physiological measures.

We are also keen to explore the new information spaces that are being created through pervasive, distributed computing environments. Here Benyon has already characterised a new HCI, concerned with the navigation of information spaces [8,10], from a semiotic perspective. Looking to lessons from architectural semiotics, interior and garden design we are looking to the design of physical environments with many embedded information and communication devices. The information space is, thus, built into the environment and people are in a very real sense inside an information space. There is a zone 1 medium that they will shape and form into an environment within which they can engage in activities.

The semiotic analysis of information spaces provides an alternative and, we believe, useful perspective on interaction with and through new media. Designers have this one-off chance, the 'one shot message', to communicate with their users. This message is the medium with which and through which people interact. This is part of the intersubjectivity that Dourish deals with, seeing 'communication between designer and user as medium' [14]. But the medium is made of interactive systems and we have developed a semiotic model of interactive systems that captures the temporal as well as spatial relations between signs (information artefacts), their denotations and their connotations. The individual also brings a host of background knowledge and interpretations to the interactions in the form of his or her 'Umwelt'. Here we see connections with the perception/action loop that characterises much phenomenology and with the interpretations through blends and metaphors suggested by Lakoff and Johnson [17].

The semiotic analysis lets us go beyond the denoted meanings of things and asks us to consider the connotations and cultural effects that designs have. We are increasingly living in a physical world augmented by virtual displays, and populated by interconnected information and communication devices. This new medium needs new approaches to assist designers and the semiotics of interactive systems is such an approach.

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